CLAIMS

What is claimed is:

1. A composite separator plate for use in a fuel cell stack of the type having a first surface and a second surface opposite said first surface, the composite separator plate comprising a polymeric material and expanded graphite dispersed in said polymeric material.

2. A composite separator plate as set forth in claim 1 wherein said expanded graphite comprises between about 10% and about 50% by volume.

3. A composite separator plate as set forth in claim 2 wherein said expanded graphite comprises between about 20% and 35% by volume.

4. A composite separator plate as set forth in claim 1 wherein said expanded graphite is in particle sizes of between about 0.4 and 3.0 millimeters.

5. A composite separator plate as set forth in claim 1 wherein said expanded graphite is in particle sizes of greater than 10 percent of the final plate thickness.

6. A composite separator plate as set forth in claim 1 wherein at least some of said expanded graphite extends from said first surface to said second surface.

7. A composite separator plate as set forth in claim 1 wherein said polymeric material is selected from the group consisting of thermoset and thermoplastic polymers.

8. A composite separator plate as set forth in claim 7 wherein said polymeric material is selected from the group consisting of: epoxy, polyvinyl ester, polyester, polypropylene, and polyvinylidene fluoride.

9. A composite separator plate as set forth in claim 1 wherein said expanded graphite is compressible.

10. A composite separator plate as set forth in claim 1 wherein said expanded graphite is porous.

11. A composite separator plate as set forth in claim 1 wherein said plate further comprises a filler material dispersed in said polymeric material.

12. A composite separator plate as set forth in claim 11 wherein said filler material is selected from the group consisting of glass fibers, metal fibers, cotton flock, polyacrylonitrile (PAN) based carbon fibers, and polymeric and metallic mesh.

13. A composite separator plate as set forth in claim 1 wherein said plate has a hydrogen permeation of less than .01 mamp/cm^2 at 25 psig, 80° C and 0.5mm).

14. A composite separator plate as set forth in claim 1 wherein said composite separator plate includes a layer of conductive material disposed over said first surface, said layer of conductive material in contact with said expanded graphite.

15. A composite separator plate as set forth in claim 14 wherein said conductive material is selected from the group consisting of gold, silver, platinum, carbon, palladium, rhodium and ruthenium.

16. A composite separator plate as set forth in claim 1 wherein said plate has an area specific resistance less than 40 milliohms · cm^2 at compression pressures less than or equal to 200 psi and greater than 25 psi.

17. A composite separator plate as set forth in claim 16 wherein said plate has an area specific resistance less than 20 milliohms · cm^2 at compression pressures greater than or equal to 200 psi.

18. A composite separator plate for use in a fuel cell stack of the type having a first surface and a second surface opposite said first surface, the composite separator plate comprising a polymeric material and a compressible conductive material dispersed in said polymeric material.

19. A composite separator plate as set forth in claim 18 wherein said compressible material comprises between about 10% and about 50% by volume.

20. A composite separator plate as set forth in claim 19 wherein said compressible material comprises between about 20% and 35% by volume.

21. A composite separator plate as set forth in claim 19 wherein said compressible material comprises expanded graphite.

22. A composite separator plate as set forth in claim 21 wherein said expanded graphite is in particle sizes of between about 0.4 and 3.0 millimeters.

23. A composite separator plate as set forth in claim 18 wherein said compressible material is in particle sizes greater than 10% of the final plate thickness.

24. A composite separator plate as set forth in claim 18 wherein at least some of said compressible material extends from said first surface to said second surface.

25. A composite separator plate as set forth in claim 18 wherein said polymeric material is selected from the group consisting of thermoset and thermoplastic polymers.

26. A composite separator plate as set forth in claim 25 wherein said polymeric material is selected from the group consisting of: epoxy, polyvinyl ester, polyester, polypropylene, and polyvinylidene fluoride.

27. A composite separator plate as set forth in claim 18 wherein said plate further comprises a filler material dispersed in said polymeric material.

28. A composite separator plate as set forth in claim 27 wherein said filler material is selected from the group consisting of glass fibers, metal fibers, cotton flock, polyacrylonitrile (PAN) bassed carbon fibers, and polymeric and metallic mesh.

29. A composite separator plate as set forth in claim 18 wherein said plate has a hydrogen permeation of less than .01 mamp/cm^2 at 25 psig, 80° C. and 0.5mm)

30. A composite separator plate as set forth in claim 18 wherein said composite separator plate includes a layer of conductive material disposed over said first surface, said layer of conductive material in contact with said expanded graphite.

31. A composite separator plate as set forth in claim 30 wherein said conductive material is selected from the group consisting of gold, silver, platinum, carbon, palladium, rhodium and ruthenium.

32. A composite separator plate as set forth in claim 18 wherein said plate has an area specific resistance less than 40 milliohms · cm^2 at compression pressures less than or equal to 200 psi and greater than 25 psi.

33. A composite separator plate as set forth in claim 32 wherein said plate has an area specific resistance less than 20 milliohms · cm^2 at compression pressures greater than or equal to 200 psi.

34. A method of manufacturing a composite separator plate for a fuel cell comprising the steps of:

preparing expanded graphite into particles;

dispersing the expanded graphite into a polymeric resin;

compression molding the resin and graphite particles to form the separator plate.

35. A method as set forth in claim 34 wherein the expanded graphite is dispersed by mixing into the polymer resin.

36. A method as set forth in claim 34 wherein the expanded graphite is dispersed by sprinkling into the polymer resin.

37. A method as set forth in claim 34 wherein said expanded graphite comprises between about 10% and about 50% by volume of the plate.

38. A method as set forth in claim 37 wherein the expanded graphite particles are prepared by grinding expanded graphite to particle sizes between about 0.4 and 3.0 mm.

39. A method as set forth in claim 38 wherein said expanded graphite particles are screened.

40. A method as set forth in claim 34 wherein the expanded graphite particles are prepared by grinding the expanded graphite to particle sizes that are greater than 10% of the final plate thickness.

41. A method as set forth in claim 38 wherein said polymeric resin is selected from the group consisting of epoxy, polyvinyl ester, polyester, polypropylene, and polyvinylidene fluoride.

42. A method as set forth in claim 34 further comprising the step of dispersing a filler material in the polymeric resin.

43. A method as set forth in claim 42 wherein said filler material is selected from the group consisting of glass fibers, metal fibers, cotton flock, polyacrylonitrile (PAN) based carbon fibers and polymeric and metallic mesh.

44. A method as set forth in claim 34 further comprising the step of removing a portion of the polymeric resin from at least a portion of one surface of the separator plate.

45. A method as set forth in claim 44 wherein the portion of the polymeric resin is removed by sanding at least a portion of one surface of the separator plate.

46. A method as set forth in claim 34 further comprising the step of disposing a conductive tie layer on at least a portion of the separator plate.

47. A method as set forth in claim 46 wherein said conductive tie layer is vapor deposited on at least a portion of the separator plate.